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(54) Writing instrument.

(57) A ball point pen writing instrument is disclosed which provides greater retractability of a replaceable ball point ink cartridge (14) by a novel arrangement of cam surfaces (76a,78a,82a,84a) on a ratchet or cam body (28a) of the ink cartridge. The cam surfaces on the ink cartridge ratchet differ substantially in shape and duration from prior existing cam surfaces having multiple 90° and 45° duration orientations, respectively. The improved ratchet cam surfaces allow the ink cartridge to be retracted in the ball point pen housing approximately one additional millimeter, thereby eliminating the possibility of ink from the ball point wicking onto cloth adjacent to the ball point end of a writing instrument when that writing instrument is positioned in a clothing pocket of a user.

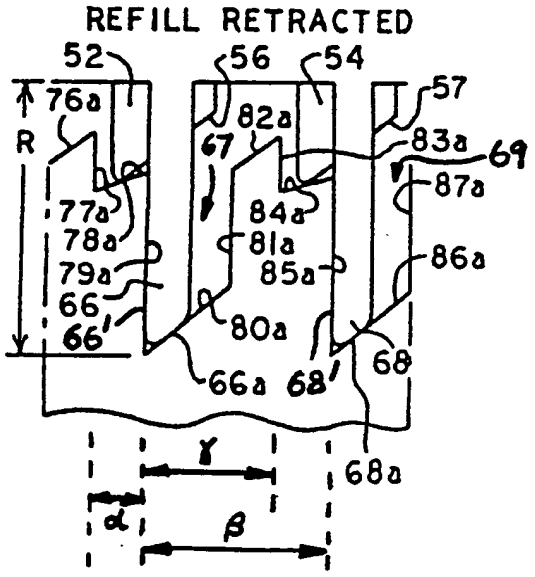

FIG. 13

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WRITING INSTRUMENT

The present invention relates generally to writing instruments and to ball point replaceable writing units or cartridges for such instruments, and relates more specifically to an improved ratchet mechanism on the cartridge for retracting the writing unit a greater distance into the housing than heretofore known.

Ball point writing instruments are known in the prior art in which a replaceable ink reservoir cartridge or writing unit is provided with means forming a basic component of the projection mechanism of the instrument. A writing instrument of this type is disclosed, for example, in US-A-3205863. The projection-retraction mechanism disclosed therein includes a ball point and cartridge unit having a cam body or ratchet member secured to the rearward end thereof and formed with a plurality of cam surfaces which are engageable by fingers extending from a tubular plunger mounted inside a rear portion of the writing instrument housing. The cam surfaces rotate with respect to, and the fingers move axially along, a pair of stop members fixedly positioned on the hollow interior of a guide member to positively move the ball point cartridge unit into alternating projected and retracted positions within the writing instrument housing.

Although such an arrangement for alternatively projecting and retracting a ball point cartridge unit has proved to be effective from the standpoint of its reliability, in known projection-retraction mechanisms the length of travel, or stroke of the writing cartridge is limited by the geometry of the existing projection-retraction mechanism. More specifically, when the cartridge occupies the retracted position within the writing instrument housing, the ball point of the cartridge is typically recessed about 1 mm plus or minus 1 mm within the housing. A problem of wicking, i.e., ink from an insufficiently retracted ball point damaging the clothes of a user, is more likely to occur with certain new types of inks having a relatively lower viscosity when subjected to shear than inks heretofore used in ball point pens.

When using a writing unit cartridge containing ink of that new type, or some other low viscosity ink, it would be desirable to employ a projection-retraction mechanism which retracts the cartridge farther into the writing instrument housing. Additionally, it would be desirable to utilize a projection-retraction mechanism which permits greater retraction of the writing unit cartridge without the necessity of redesigning any of the existing components of the mechanism which are permanently assembled within the writing instrument itself.

Thus, it would be desirable to achieve greater retraction of a cartridge unit by modifying only the cam body of the replaceable cartridge unit. Such an objective would permit improved cartridge units having the newer less viscous ink therein to be used interchangeably with prior cartridge units in known writing instrument assemblies presently being used by the public.

According to the present invention there is provided a writing instrument having a tubular housing, a cartridge unit slidably mounted in the housing for movement between a forward projected position and a rearward retracted position, a spring urging the cartridge unit rearwardly toward said retracted position, and a projection-retraction mechanism for controlling the position of the cartridge unit in the housing, the projection-retraction mechanism comprising:

a cylindrical ratchet body connected to the cartridge unit and including a plurality of angularly spaced rearwardly facing cam surfaces inclined relative to the longitudinal axis of the housing;

depressible actuator means mounted, for longitudinal movement, in the housing;

means for restraining the depressible actuator means against rotation relative to the housing;

guide means disposed within the housing for rotatably and slidably receiving the ratchet body and the cartridge unit;

a pair of diametrically spaced stop members fixedly disposed in and extending parallel to the longitudinal axis of the housing, the stop members each having a forward end surface and a longitudinally extending side surface, the inclined cam surfaces being engageable by the forward end surfaces of the stop members for stopping rearward movement of the ratchet body in the housing;

the depressible actuator means including a plurality of spaced camming fingers, the forward end of each camming finger having an inclined cam follower surface thereon;

the ratchet body having longitudinally extending first stop surfaces adapted to engage the longitudinally extending side surfaces of the stop members when said cartridge unit is in the projected position to arrest rotation of the ratchet body with the forward end surfaces of the stop members in abutment with the cam surfaces on the ratchet body and thereby prevent rearward movement of the cartridge unit from the projected position,

the ratchet body further having longitudinally extending second stop surfaces adapted to engage the longitudinally extending side surfaces of the stop members when the cartridge unit is in the retracted position to arrest rotation of the ratchet

body in the housing;

the cam follower surfaces on the depressible means cooperating with the inclined cam surfaces on the ratchet body upon successive depressions of the depressible means to rotate the ratchet body from the retracted position wherein one of the second stop surfaces is engaged by one of the side surfaces, to the projected position wherein one of the first stop surfaces is engaged by the same one of the side surfaces;

characterized in that

the said second stop surface is spaced from the respective first stop surface by an angular distance which is significantly less than one-half the angular rotation between successive similar operative positions.

The invention also includes a cartridge unit of this type, characterized in that the angular distance between the second stop surface and the respective first stop surface is significantly less than half the angular distance between adjacent second stop surfaces or adjacent first stop surfaces.

A prior art example and two examples of writing instruments according with the invention will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a longitudinal sectional view taken through the housing of a preferred embodiment of the invention showing the internal members in elevation, the writing cartridge unit being in a projected position within the housing;

Fig. 2 is an exploded view in elevation of the writing cartridge unit and the projecting-retracting mechanism;

Fig. 3 is a fragmentary longitudinal, sectional view through the rearward portion of the writing instrument taken substantially along line 3-3 of Fig. 1 showing the writing cartridge unit and the projecting-retracting mechanism in their projected positions;

Fig. 4 is a fragmentary, longitudinal sectional view taken substantially along line 4-4 of Fig. 3 showing the writing cartridge unit and projecting-retracting mechanism in their projected positions;

Figs. 5, 6, 7 and 8 are diagramatic developed views illustrating step-by-step the manner in which camming surfaces of a displaceable cam body carried by the writing cartridge unit are engaged alternatively by stationary actuating means and actuating means longitudinally movable with a push button to effect the retracting-projecting operation of the writing cartridge unit in known ball point pen assemblies;

Figs. 9, 10, 11 and 12 are transverse sectional views similar to Fig. 3, but taken from known ball point pen assemblies showing the actual relative positions of the camming portions of the cam body and the actuating means shown most clearly in Figs. 5, 6, 7 and 8, respectively;

Figs. 13, 14, 15 and 16 are diagramatic developed views similar to the views of Figs. 5-8 illustrating a preferred embodiment of the present invention wherein the ratchet or cam body is constructed with a different geometric configuration than the cam body of the prior art;

Figs. 17, 18, 19 and 20 are transverse sectional views similar to Fig. 3, showing the actual relative position of the camming portions of the ratchet or cam body and the actuating means illustrated in Figs. 13, 14, 15 and 16, respectively;

Figs. 21, 22, 23 and 24 are diagramatic developed views similar to the views of Figs. 5-8 and 13-16 of a second embodiment of the present invention illustrating the manner in which camming surfaces of the ratchet or cam body are engaged alternatively by the stationary actuating means and actuating means longitudinally movable with a push button; and

Figs. 25, 26, 27 and 28 are transverse sectional views similar to Fig. 3, showing the actual relative positions of the camming portions of the cam body and the actuating means in the invention illustrated in Figs. 20, 21, 22 and 23.

Referring now to the drawings, and initially to Fig. 1, there is illustrated a writing instrument, designated generally by the reference numeral 10, comprising a forward tubular housing member 12 having a writing unit 14 slidably mounted therein for movement between a forward projected position and a rearward retracted position. A cap assembly, designated generally by the reference numeral 16 and which will be described in detail hereinafter, is threadedly secured to the rearward end of the tubular housing 12. The writing unit 14 is preferably of a cartridge or modular type having an ink reservoir section 18 leading to a reduced ink feed section 20 which carries a ball writing tip 22. The writing unit 14 is biased to a retracted position by a retracting spring 24 which is mounted concentrically with the reduced ink feed section 20 and bears against a shoulder 26 formed at the juncture between the reservoir end 18 and the reduced ink feed section 20. The cartridge 14 carries a cylindrical ratchet or cam body 28 secured on the rearward end thereof, preferably by crimping or punching.

The cap assembly 16 includes a generally tubular rearward housing 30 having a clip 32 mounted on the external surface thereof. As best seen in Figs. 1 and 2, housing member 30 is provided with a rearwardly facing circular opening 34 which receives and supports a depressible actuator button 36 for axial movement within the cap assembly 16. An internal shoulder 38 formed in the rearward

housing member 30 inwardly adjacent opening 34 cooperates with an annular ridge 40 provided on the surface of the actuator button 36 to prevent escape of the actuator button 36, retaining it in the cap assembly 16. At its forward end adjacent the annular ridge 40, the actuator button 36 is formed with an integral collar 42.

Forwardly of the actuator button 36, the cap assembly 16 includes a generally tubular plunger 44 having an internal opening which is sized to receive the collar 42 of the actuator button 36. An annular rim 46 formed at the rearward end of the plunger 44 and the actuator button 36 outwardly of the rearward housing 30. Diametrically opposite fingers 52 and 54 extend forwardly on the plunger and terminate at forwardly facing inclined cam follower surfaces 56, 57, respectively, for purposes which will be described in detail hereinafter.

As shown most clearly in Figs. 3 and 4, an additional component of the cap assembly 16 is a ratchet restraining frame 58. The ratchet frame 58 is secured within the rearward housing 30, preferably by ultrasonic welding and, therefore, is fixedly positioned within the cap assembly 16. A central bore 60 through the ratchet restraining frame 58 provides a guide means for the cylindrical ratchet or cam body 28a of the cartridge 14 such that the cam body 28a is rotatably and slidably disposed within the restraining frame 58. At its forward end, the ratchet frame 58 is adapted with an internal thread, designated generally by the reference numeral 62, which cooperates with an external thread 64 provided on the rearward end of the tubular housing 12, thereby serving as a convenient means for connecting and disconnecting the two housing members 12 and 30, respectively. The writing instrument 10 may thereby be manually disassembled for removal and replacement of the ink cartridge 14. Two diametrically opposite stop members 66 and 68 project into the central bore 60 of the ratchet restraining frame 58 and extend longitudinally therewithin. The stop members 66 and 68 are each received within a corresponding groove 70 and 72, respectively, of the plunger 44 such that the plunger fingers 52 and 54 are longitudinally slidable within the ratchet restraining frame in close, parallel relation to stop members 66 and 68, respectively. The forward ends of stop member 66 and 68 are configured with cam follower surfaces 66a, 68a, respectively. The forwardly facing cam follower surfaces 56 and 57 of the respective fingers 52 and 54 engage and rotate the ratchet 28 on the cartridge 14 when button 36 is depressed.

The cylindrical ratchet or cam body 28a is provided with a plurality of cam surfaces 76a through 87a which are spaced about a central hub portion 83. The cam surfaces 76a through 87a are engageable by fingers 52 and 54 of the plunger and also by stop members 66 and 68 of ratchet restraining frame 58 to stop the rotation of the cartridge when button 36 is released by a user.

The hub 83 of the cam body 28a maintains proper axial alignment between the plunger 44 and the cam body while allowing rotation of the cartridge 14 with respect to the tubular housing 2 and cap 16 when the button 36 and plunger 44 are depressed.

The longitudinal and radial orientation of the cam surfaces 76 through 87 of heretofore known cartridge ratchet or cam bodies 28 is shown most clearly in Figs. 5-12 and, more particularly, in Figs. 5, 6 and 10. As shown most clearly in Fig. 5, when the cartridge unit is fully retracted in the pen, the stop members 66 and 68 are not positioned to utilize the full depth of the deep grooves defined by trailing edge 79, bottom surface 80, leading edge 81 or trailing edge 85, bottom edge 86 and leading edge 87. Greater retraction cannot be obtained utilizing the known ratchet or cam body configuration because in retraction, the lagging sides 79, 85 of the deep grooves stop rotationally against stop members 66, 68 of the ratchet frame 58, and stop longitudinally against the plunger fingers 52, 54 thereby stopping the ratchet in the retracted position with the writing point of the cartridge retracted about 1 mm. into the barrel.

As shown most clearly in Figs. 6 and 10, in known prior art ratchet mechanisms, each of the cam faces 76, 82 (over which fingers 52, 54 must ride so that the stop members 66, 68 may be positioned in the deep retraction grooves) is a 45° segment of the circumference of the ratchet or cam body. The camming surfaces 78, 84 (on which fingers 52, 54 and stop members 66, 68 ride during extension) are 90° or one-quarter of the circumference of the ratchet 28. The two deep grooves (defined respectively by trailing edge 79, bottom camming surface 80, and leading edge 81, and by trailing edge 85, bottom camming surface 86, and leading edge 87) each occupy 45° of the circumference of the ratchet body. Camming surfaces 82, 84 and 86 together take up 180° of the circumference of the ratchet body 28. Camming surfaces 76, 78, 80 together take up the other 180° thereof.

In the prior art ratchet or cam body 28, the angle of the cam surfaces 76, 78, 82 and 84 with the horizontal is approximately 28.5°. Cam surfaces 80 and 86 are horizontal.

In the first and preferred embodiment of the present invention, shown most clearly in Figs. 13 through 20, the circumferential segments of the ratchet body 28 cam surfaces 76a through 87a differ from that disclosed in the prior art.

Cam surfaces 76a and 82a have reference angles approximating 28.5° with the horizontal. Cam surfaces 78a and 84a have reference angles of 20.94° with the horizontal, and cam surfaces 80a and 86a have reference angles of 40.69° with the horizontal. As shown most clearly in Fig. 13, when the ratchet frame body stop members 66, 68 are positioned in the deep grooves 67,69 (defined by 79a, 80a, 81a, and 85a, 86a and 87a, respectively), the entire depth of those deep grooves is utilized by the stop members, thus increasing the retraction of the cartridge 14 in the pen by approximately 1.0 mm. The deep grooves 67,69 are also deeper by about 1.27 mm than in the prior art, the new depth being 9.271 mm. Also, the lowering of the leading end of cam surfaces 78a and 84a provides for greater retraction as fingers 52 and 54 are positioned deeper in the ratchet body 28a during retraction.

As shown most clearly in Figs. 14 and 18, each of cam surfaces 76a, 82a is located at the same radial position on the ratchet body but covers only a 35° circumferential segment, instead of 45°. Also, cam surfaces 78a, 84a have been made much smaller than cam surfaces 78, 84 in the prior art, and each covers only 65° of the circumference of ratchet body 28a, instead of 90° as in the prior art. The deep groove cam surfaces 80a, 86a have been largely expanded and each now occupies 80° of the circumference of the ratchet body, instead of 45°.

As shown most clearly in Figs. 21 through 28, a second embodiment of the present invention utilizes a still different configuration for the camming surfaces of ratchet body 28b. In this embodiment, the angle of cam surfaces 76b and 82b are, similarly with the ratchet body of the prior art, maintained at approximately 28½° with the horizontal. Also, camming surfaces 80b and 86b are horizontal as in the prior art. Cam surfaces 78b and 84b have reference angles of 20.56° with the horizontal. As shown most clearly in Fig. 21, when the ratchet frame body stop members 66, 68 are positioned in the two deep grooves defined by 79b, 80b, 81b, and by 85b, 86b and 87b, respectively, the entire depth of those grooves is utilized by the stop members, thus increasing the retraction of the cartridge 14 in the pen by approximately 1.0 mm. The deep grooves are also deeper by about 1.27 mm than in the prior art, the new depth being 9.271 mm. Also, the lowering of the leading ends of cam surfaces 78b and 84b provides for greater retraction as fingers 52 and 54 are positioned deeper in the ratchet body 28b during retraction.

As shown most clearly in Figs. 22 and 26, each of cam surfaces 76b, 82b covers a 70° segment of, and each of cam surfaces 78b, 84b covers a 65° segment of, the circumference of the ratchet body 28b. Each of cam surfaces 80b, 86b covers a 45° segment.

The advantages of the present invention can be appreciated from comparison of the operation of the prior art projection-retraction mechanism illustrated in Figs. 5 through 12 with the operation of the first preferred embodiment shown in Figs. 13 through 20, and with the second preferred embodiment shown in Figs. 21 through 28.

In the retracted disposition of the prior art mechanism, as illustrated in Figs. 5 through 12, for example, the two deep grooves 67,69 (bottomed by cam surfaces 80, 86) of the ratchet 28 receive stop members 66 and 68, respectively, but only partially such that their cam follower surfaces 66a, 68a do not in the retracted position engage bottom cam surfaces 80, 86. Stop members 66, 68 abut lagging side surfaces 79 and 85, due to cooperation between the fingers 52 and 54 and the angled cam surfaces 78 and 84, respectively, and do not reach the full depth of the deep grooves. During extension of the writing unit to a projected position, as illustrated in Figs. 6 and 10, fingers 52 and 54 are extended such that stop members 66 and 68 clear the lagging surfaces 79, 85 of the deep grooves, and the fingers 52, 54 are moved along cam surfaces 78 and 84 respectively, into engagement with side surfaces 77 and 83 of the ratchet body 28. As the button 36 is released, fingers 52 and 54 are retracted, and stop members 66 and 68 engage the side surfaces 77, 83, as illustrated in Figs. 7 and 11 which show the fully projected disposition of the projection-retraction mechanism. Finally, during retraction, which is shown in Figs. 8 and 12, fingers 52 and 54 engage cam surfaces 76 and 82 to move the ratchet body 28 such that side surfaces 77 and 83 clear the stop members 66 and 68, respectively, and because of the spring biasing (as shown in Fig. 1), cause the ratchet body 28 to shift rotationally once again to the retracted disposition of Figs. 5 and 9.

Operation of the projection-retraction mechanism of a writing instrument 10 employing a first preferred embodiment of the invention is best seen in the developed views of Figs. 13-20. Figs. 13 and 17, for example, illustrate the disposition of cylindrical ratchet body 28a, fingers 52 and 54 and stop members 66 and 68 when the cartridge 14 is in a retracted position within the writing instrument 10. In such a disposition, the deep grooves 67,69 (defined by surfaces 79a, 80a, and 81a, and 85a, 86a and 87a, respectively) of the ratchet body 28 receive stop members 66 and 68, respectively, such that their cam follower surfaces 66a and 68a

engage bottom cam surfaces 80a, 86a. The cartridge 14 is maintained in this retracted position due to the biasing force of the retracting spring 24 against the cartridge 14, and the fingers 52 and 54 of the plunger 44 occupy a position in engagement with the cam surfaces 78a and 84a, respectively, of the ratchet body 28a. Because of the slope of bottom surfaces 80a, 86a, in contact with surfaces 66a, 68a, the side surfaces 79a, 85a of the deep grooves are urged rotationally into abutment with the stationary stop members 66 and 68, respectively.

During extension of the ink cartridge 14, and as best seen in Figs. 14 and 18, the actuator button 36 is depressed and fingers 52 and 54 of the plunger extend forwardly until cam surfaces 78a and 84a reach the level of the distal ends 66a, 68a of stop members 66 and 68 whereupon the slope of the cam surfaces 78a and 84a causes the ratchet body 28 to shift rotationally with respect to the fingers 52 and 54. The shifting motion is limited by abutment of side surfaces 79a, 85a with the respective fingers 52 and 54. To complete the extension of the ink cartridge 14, the actuator button 36 and fingers 52 and 54 are retracted, whereupon the ratchet 28a is shifted rotationally until lagging surfaces 77a, 83a are in abutment with stop members 66 and 68. In this disposition, as illustrated in Fig. 15 and 19, the ball writing tip 22 of the ink cartridge 14 is projected from the forward tubular housing 12 such that the instrument 10 may be used for writing. Finally, during retraction and as best illustrated in Figs. 16 and 20, the actuator button 56 is again depressed such that fingers 52 and 54 engage cam surfaces 76a and 82a respectively, and are further extended until the stop member distal ends 66a and 68a clear the leading ends of surfaces 77a, 85a, respectively, and the ratchet body 28a then shifts rotationally until the stop members 66 and 68 once again occupy the full depth of the deep grooves and, engaging cam surfaces 80a and 86a, thereby completing the projection-retraction cycle.

Turning now to Figs. 21-28, a second embodiment of the present invention is illustrated wherein the cylindrical ratchet body 28b is formed with a geometric configuration differing from the ratchet body 86 28a of the first preferred embodiment and from the prior art ratchet body 28. In the second embodiment cam surfaces 76b and 82b occupy about 25° more than the 45° of the prior art, or about 70° each, and cam surfaces 78b and 84b are shortened from the 90° in the prior art to about 65° each. The shortening of surfaces 78b and 84b moves the new deep grooves (79b, 80b, 81b and 85b, 86b, 87b) each about 25° clockwise and lowers the shoulder between surfaces 78b, 79; and between 84b, 85b so stop members 66 and 68 extend farther into the deep grooves for greater retraction. Extension cam surfaces 78b, 84b are at an angle with the horizontal of about 20 1/2°, compared with about 28 1/2° in the prior art for surfaces 78, 84, thus further lowering the shoulder between surfaces 78b, 79b and between surfaces 84b, 85b. The deep grooves remain 45° in circumferential duration, as in the prior art, but are about 1.27 mm deeper than in the prior art. The four operation steps shown in Figs. 21-28 are similar to those described previously. In Fig. 21, the stop member 66, 68 are received in the deep grooves (79b, 80b, 81b and 85b, 86b, 87b, respectively) such that those members abut the lagging side surfaces 79b, 85b, respectively, and do not extend to the bottom cam surfaces 80b, 86b, respectively, being in this respect similar to the prior art. However, with the deep grooves being positioned approximately 25° clockwise of their prior art positions, and with the height of the shoulder between deep groove surfaces 78b, 79b, and 84b, 85b being lower than that corresponding shoulder in the prior art (Fig. 5), the stop members 66 and 68 are able to extend further into their respective deep grooves than was possible in the prior art as shown in Fig. 5.

Figs. 22 and 26 show the second embodiment of the present invention when the button 36 is pushed inward and fingers 52, 54 push the ratchet body 28b as far forward as needed for the distal ends 66a, 68a to clear or rise over the shoulder between surfaces 78b, 79b and 84b, 85b, respectively, and come in contact with the cam surfaces 78b and 84b. As the button 36 is retracted, the relationship between stop members 66, 68, and cam body 28b is that as is shown in Figs. 23 and 27 with the leading sides of the stop members 66, 68 abutting side surfaces 77b, 83b, respectively. During retraction, which is shown in Figs. 24 and 28, fingers 52 and 54 are again depressed and ratchet body 28b is pushed until stop members 66 and 68 clear the shoulders between cam surfaces 76b and side surface 77b, and cam surface 82b and side surface 83b, respectively; and once that shoulder is cleared, the bias of spring 24 between shoulder 26 and housing 12 causes the ratchet body to rotate counterclockwise to move cam surfaces 75b, 82b along ends 66a, 68a of the stop members 66, 68 until those members again reside in the long grooves as is shown in Figs. 21 and 25.

It can be appreciated from comparison of the prior art projection-retraction mechanism illustrated in Figs. 5-12 against the mechanisms of the present invention illustrated in Figs. 13-20 and Figs. 21-28, that an increase in the stroke length of the writing unit 14 on the order of about 1.0 mm. is achieved by employing a projection-retraction mechanism utilizing either of the improved ratchet bodies 28a or 28b. The principal difference between these members and the prior art ratchet

body 28 resides in the use and increase in length of the deep grooves by stop members 66, 68, and in the change in the degree of rotational shifting of the ratchet bodies 28a and 28b between the fully projected and the fully retracted dispositions of the assembly 16, and in the change in the slope of the extension cam surfaces. In this regard, Fig. 13 illustrates that in the retracted disposition, the stop members 66 and 68 are in abutment with side surfaces 79a, 85a, of the ratchet body 28a while Fig. 15 illustrates that in the projected disposition the stop members 66 and 68 are in abutment with side surfaces 77a, 83a. In operation, rotational shifting of the ratchet body 28a between these two positions of the stop members 66 and 68 is substantially less than 90°, i.e., the rotational shifting between retracted and projected position is substantially less than one-half the angular rotation between successive projected positions. The same is true in the second embodiment of Figs. 21-28. Fig. 21 illustrates that in the retracted position the stop members 66 and 68 are in abutment with side surfaces 79b, 85b while in the fully projected position the same stop members 66 and 68 abut side surfaces 77b, 83b. Thus, rotational shifting of the cam body 28b is likewise substantially less than 90°, i.e., is substantially less than one-half the angular rotation between successive projected positions. In practice, it is preferred that rotational shifting of the cam bodies 28a and 28b is limited to on the order of 65°; in other words, that the angular separation between stop surfaces 77a and 79a and stop surfaces 77b and 79b is approximately 65°. By comparison, in the prior art projection-retraction mechanism illustrated in Figs. 5-12, shifting of the cam body 28 between a retracted position wherein cam surfaces 79, 85 are in abutment with stop members 66 and 68 and a projected position wherein cam surfaces 77, 83 are in abutment with the stop members, is approximately one-fourth of the full rotation of the ratchet body 28, or 90°, which is one-half the angular rotation between successive projected positions. The result of limiting rotation of the cam body 28a and 28b of the first and second embodiments to substantially less than one-half the angular rotation between successive projected positions, is that a greater stroke length of the writing cartridge unit 12 is obtained than the stroke length of the prior art mechanism. This is confirmed by comparing the differences between the distances identified in the drawings as R and P, wherein R represents the minimum retracted distance between the ink cartridge 14 and the ratchet frame 58, and P represents the maximum projected distance between the cartridge 14 and frame 58. P minus R in the prior art device is 4.66 mm. P minus R in the first embodiment of the invention is 5.60 mm and in the second embodiment of the invention is 5.60 mm.

The combined circumferential segment of the transitional cam surface and the adjacent retraction cam surface in both embodiments of the invention shown and described is 115°. In the first embodiment, that combination consists of the 35° segment and the 80° segment. In the second embodiment, that combination consists of the 70° segment and the 45° segment. In each of the embodiments of the invention, this combined segment may be 115° plus or minus 4°, or a range for the combined segment of from 111° to 119°. In both embodiments, the rotational shifting of the cam body between retracted and extended stop surfaces, as shown and described is 65°, and the range for that shifting is accordingly from 69° to 61°, corresponding to the range for the said combined segment of from 111° to 119°.

It can further be appreciated that the present invention increases the stroke length in the writing instrument 10, utilizing an ink cartridge 14 provided with a cylindrical ratchet body having such a geometric configuration that the ball writing tip 22, in projected position, extends a normal distance from the forward tubular housing 12, and yet the ballpoint 22 will, in retracted position, retract a significantly greater distance within the housing 12. Accordingly, the writing instrument 10 may be utilized with both a conventional, unmodified, ink cartridge unit, and with a modified unit having a ratchet body in accordance with the present invention. Moreover, such a modified ink cartridge unit, filled with a type of ink having low viscosity, will, be sufficiently retracted within the housing 12 of the writing instrument 10 such that wicking of the ink into the clothing of the user will be eliminated.

Claims

1. A writing instrument having a tubular housing (12), a cartridge unit (14) slidably mounted in the housing for movement between a forward projected position and a rearward retracted position, a spring (24) urging the cartridge unit rearwardly toward said retracted position, and a projection-retraction mechanism for controlling the position of the cartridge unit in the housing, the projection-retraction mechanism comprising:

a cylindrical ratchet body (28a) connected to the cartridge unit and including a plurality of angularly spaced rearwardly facing cam surfaces (76a,78a,82a,84a) inclined relative to the longitudinal axis of the housing;

depressible actuator means (36,44) mounted, for

longitudinal movement, in the housing;

means (66,68;70,72) for restraining the depressible actuator means against rotation relative to the housing;

guide means (58) disposed within the housing for rotatably and slidably receiving the ratchet body and the cartridge unit;

a pair of diametrically spaced stop members (66,68) fixedly disposed in and extending parallel to the longitudinal axis of the housing, the stop members each having a forward end surface (66a,68a) and a longitudinally extending side surface (66',68'), the inclined cam surfaces (76a,78a,82a,84a) being engageable by the forward end surfaces of the stop members for stopping rearward movement of the ratchet body in the housing;

the depressible actuator means (36,44) including a plurality of spaced camming fingers (52,54), the forward end of each camming finger having an inclined cam follower surface (56,57) thereon;

the ratchet body having longitudinally extending first stop surfaces (77a,83a) adapted to engage the longitudinally extending side surfaces (66',68') of the stop members (66,68) when said cartridge unit is in the projected position to arrest rotation of the ratchet body with the forward end surfaces (66a,68a) of the stop members (66,68) in abutment with the cam surfaces (78a,84a) on the ratchet body and thereby prevent rearward movement of the cartridge unit from the projected position,

the ratchet body further having longitudinally extending second stop surfaces (79a,85a) adapted to engage the longitudinally extending side surfaces (66',68') of the stop members when the cartridge unit is in the retracted position to arrest rotation of the ratchet body in the housing;

the cam follower surfaces (56,57) on the depressible means cooperating with the inclined cam surfaces (76a,78a,82a,84a) on the ratchet body upon successive depressions of the depressible means to rotate the ratchet body from the retracted position wherein one of the second stop surfaces (79a,85a) is engaged by one of the side surfaces (66',68') to the projected position wherein one of the first stop surfaces (77a,83a) is engaged by the same one of the side surfaces;

characterized in that

the said second stop surface (79a,85a) is spaced from the respective first stop surface (77a,83a) by an angular distance (α) which is significantly less than one-half the angular rotation (β) between successive similar operative positions.

2. A writing instrument according to claim 1, wherein the said angular distance (α) is significantly less than 90°.

3. A writing instrument according to claim 1, wherein the inclined cam surfaces include first (76a) and second (78a) inclined cam surfaces respectively disposed on opposite sides of each second stop surface (77a).

4. A writing instrument according to any of claims 1 to 3, wherein the ratchet body further includes first and second longitudinal grooves having a width significantly greater than the width of the stop members (66,68), the grooves each having at the forward end thereof an inclined cam surface (80a,86a), and the stop members (66,68) each having a cam follower (66a,68a) at the forward end for engagement with the inclined cam surfaces of the grooves during movement of the cartridge unit (14) from the projected position to the retracted position.

5. A writing instrument according to claim 3, wherein the first inclined cam surfaces (76a,82a) are steeper than the second inclined cam surfaces (78a,84a), the second inclined cam surfaces being disposed adjacent to respective ones of the second stop surfaces (79a,85a).

6. A writing instrument according to any of claims 1 to 5, wherein the longitudinally extending first stop surfaces (77a,83a) are spaced from the next adjacent ones of the second stop surfaces (79a,85a) by angular distances of (γ) from 111° to 119°, and (α) from 69° to 61°, respectively.

7. A writing instrument according to claim 6, wherein the longitudinally extending first stop surfaces (77a83a) are spaced from the adjacent second stop surfaces surfaces (79a,85a) by angular distances of (γ) 115° and (α) 65° respectively.

8. A cartridge unit (14) for an elongate writing instrument having a projection-retraction mechanism (36,44) mounted in the rear portion of a tubular housing (12) for positioning the cartridge unit between a forward projected position and a rearward retracted position, the projection-retraction mechanism including a pair of diametrically spaced longitudinally extending stop members (66,68) fixedly mounted in said housing and actuator means (52,54) slidably mounted in the housing for longitudinal movement between forward and rearward positions, the actuator means including a pair of forwardly extending diametrically spaced fingers each having a cam follower surface (56,57) at the forward end thereof, and spring means (24) mounted in the housing for urging the cartridge unit toward the rear of the housing;

the cartridge unit (14) having a writing tip (22) at the forward end and a ratchet body (28) affixed to the rear end;

the ratchet body having a pair of diametrically spaced, longitudinal grooves (67,69) and first and second sets of rearwardly facing inclined cam surfaces (76a,78a;82a,84a) for selective engagement

with the forward end surfaces (66a,68a) of the stop fingers and the cam follower surfaces (56,57) of the spaced fingers of the actuator means (36,44) in use;

each of the sets of cam surfaces being identical and each having a first (76a,82a) and a second (78a,84a) inclined cam surface portion separated by a first longitudinal stop surface (77a,83a) providing a step between the first and second inclined cam surfaces, and a second longitudinal stop surface (79a,85a) separating the groove (67,69) from the second inclined cam surface (78a,84a);

the first and second inclined cam surfaces (76a,78a,82a,84a) sloping rearwardly in the direction of the second longitudinal stop surfaces (79a,85a);

characterized in that

the angular distance (α) between the second stop surface (79a,85a) and the respective first stop surface (77a,83a) is significantly less than half the angular distance (β) between adjacent second stop surfaces (79a,85a) or adjacent first stop surfaces (77a,83a).

9. A cartridge unit according to claim 8, wherein the grooves (67,69) have an angular width which is substantially greater than the respective angular width of the stop members (66,68); cam follower means (66a,68a) are provided at the forward ends of the stop fingers, and rearwardly facing inclined cam surfaces (80a,86a) are disposed at the forward ends of the grooves for operative engagement with the cam follower means during movement of the cartridge unit from the projected position to the retracted position.

10. A cartridge unit according to claim 8 or claim 9, wherein the said angular distance (α) is significantly less than 90°.

11. A cartridge unit according to any of claims 8 to 10, wherein the longitudinally extending first stop surfaces (77a,83a) are spaced from the adjacent second stop surfaces (79a,85a) by angular distances (γ) of from 111° to 119°, and (α) from 69° to 61°, respectively.

12. A cartridge unit according to any of claims 8 to 11, wherein the angular dimension of each first inclined cam surface (76a,82a) is substantially 35°, the angular dimension of each groove (67,69) is substantially 80°, and the angular duration of each second inclined cam surface (78a,84a) is substantially 65°.

13. A cartridge unit according to any of claims 8 to 11, wherein the angular dimension of each first inclined cam surface (76a,82a) is substantially 70°, the angular dimension of each groove (67,69) is substantially 45°, and the angular duration of each second inclined cam surface (78a,84a) is substantially 65°.

14. A cartridge unit according to any of claims 8 to 13, wherein the angle of each second inclined cam surface (78a,84a) relative to the plane normal to the longitudinal axis is substantially less than the angle of each first inclined cam surface (76a,82a), to lower the leading edge of the first inclined cam surface and provide for greater retraction of the cartridge in any ball point pen housing in which it may be mounted.

15. A cartridge unit according to claim 14, wherein the angle of each second inclined cam surface (78a,84a) is substantially 20½°.

16. A writing instrument which includes a cartridge unit according to any of claims 8 to 15.

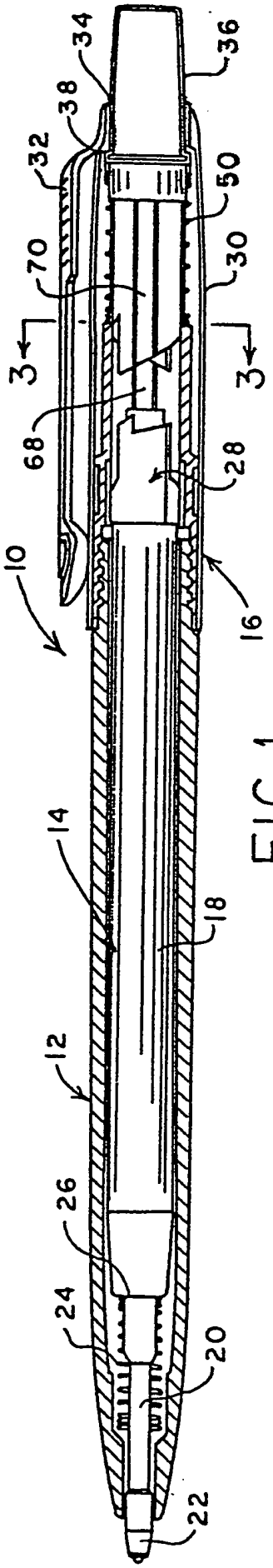

FIG. 1

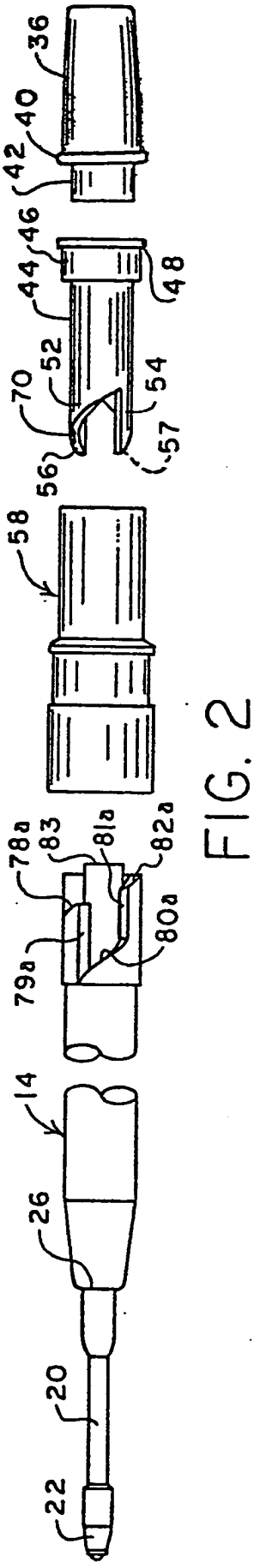

FIG. 2

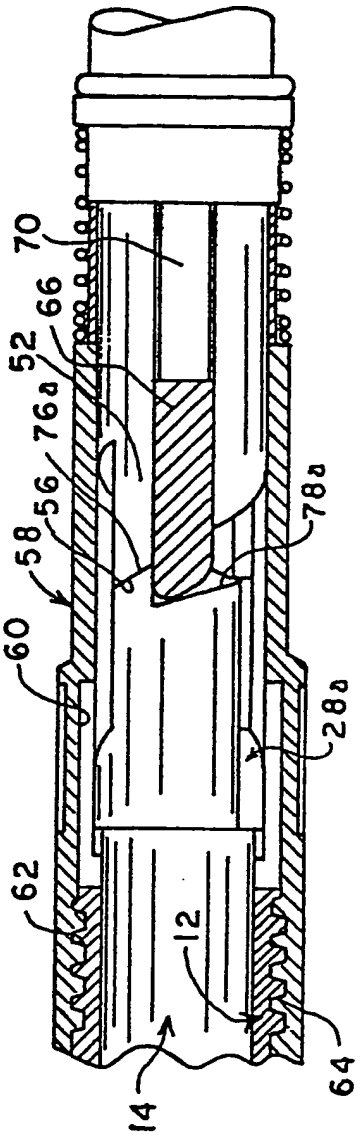

FIG. 4

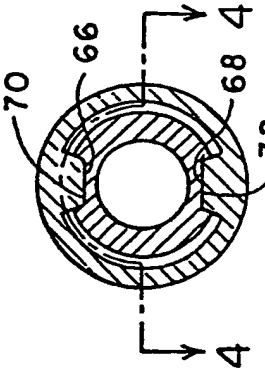

FIG. 3

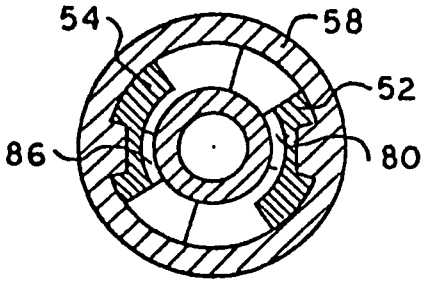

FIG. 9

PRIOR ART

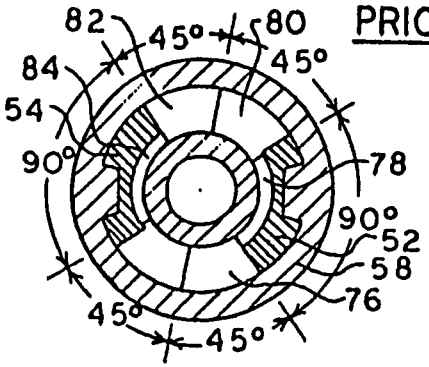

FIG. 10

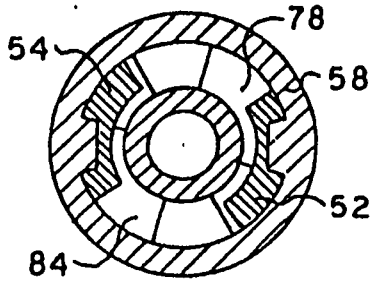

FIG. 11

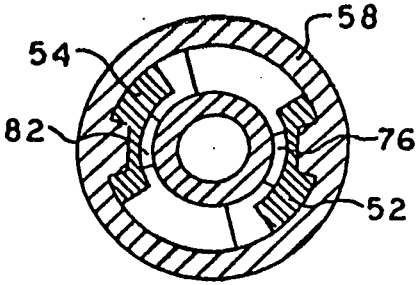

FIG. 12

PRIOR ART

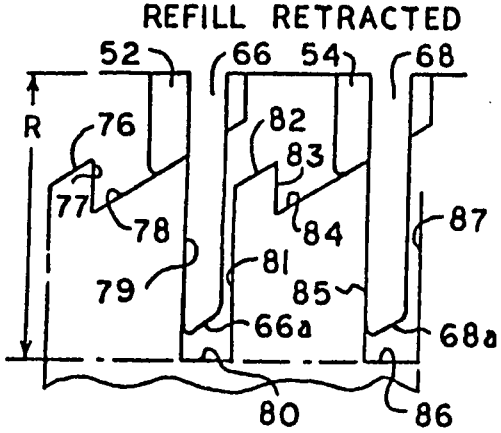

FIG. 5

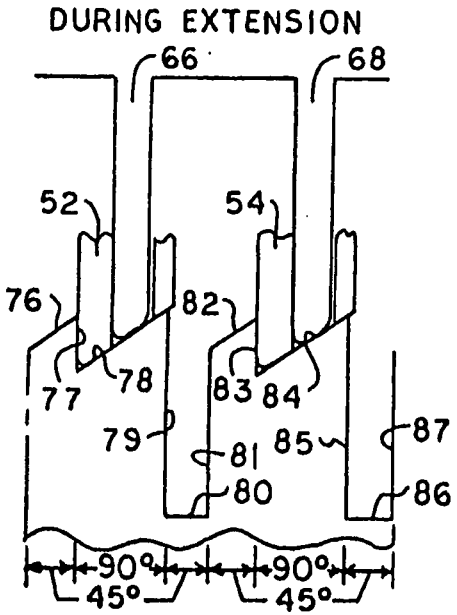

FIG. 6

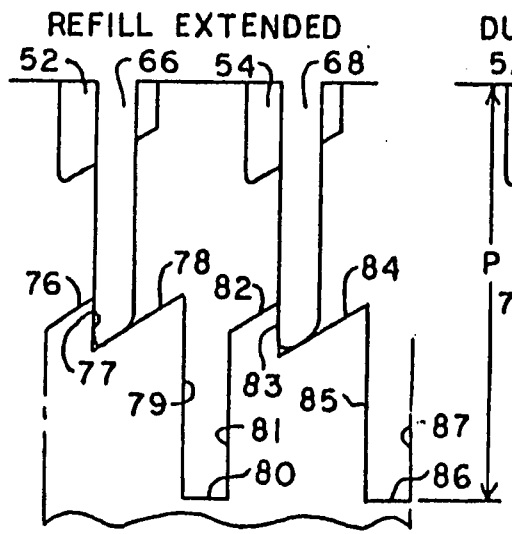

FIG. 7

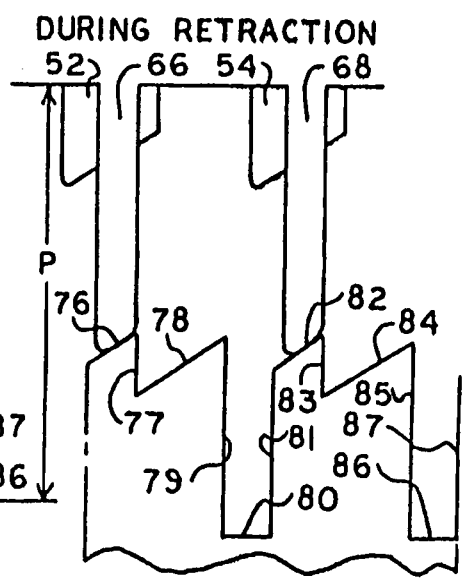

FIG. 8

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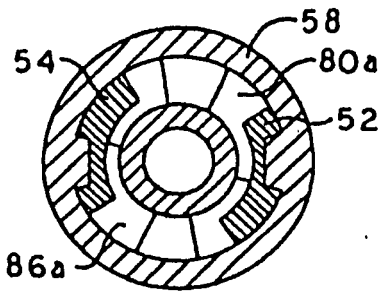

FIG. 17

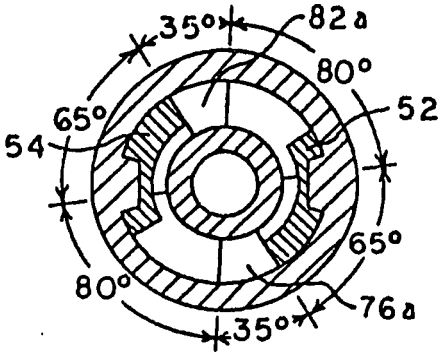

FIG. 18

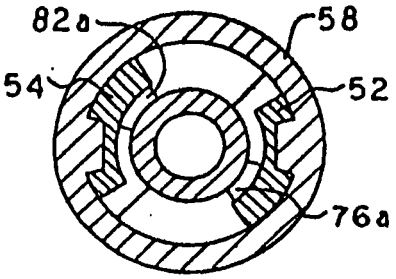

FIG. 19

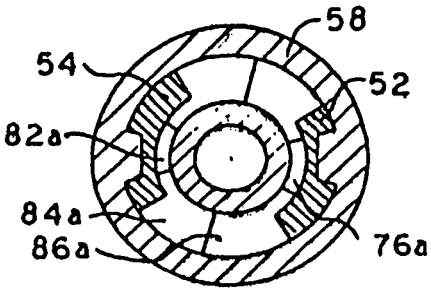

FIG. 20

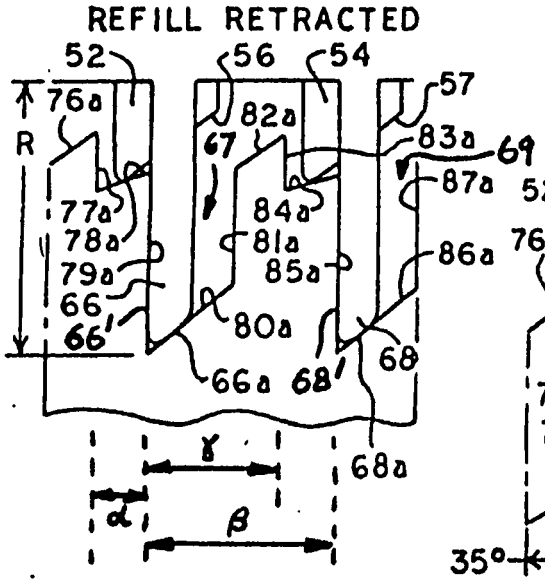

FIG. 13

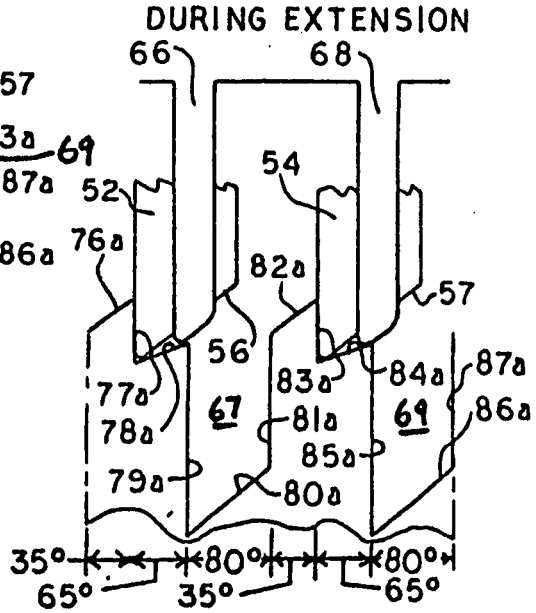

FIG. 14

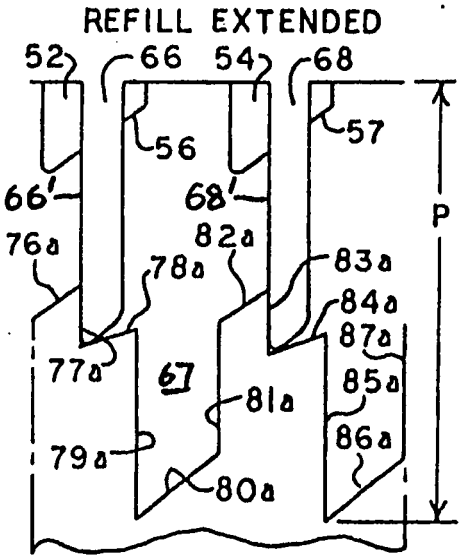

FIG. 15

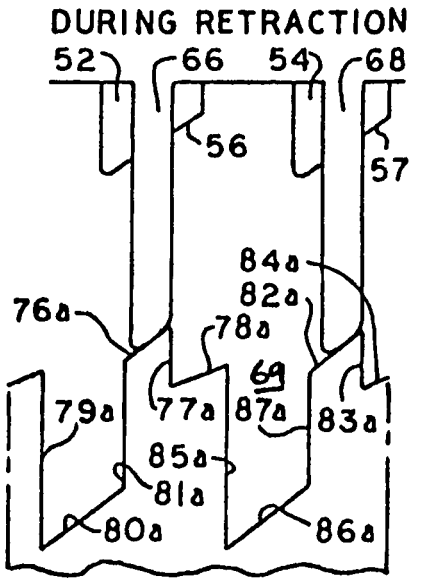

FIG. 16

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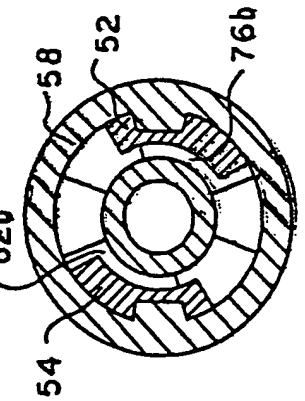

FIG. 28

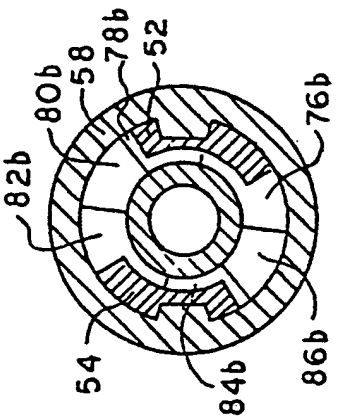

FIG. 27

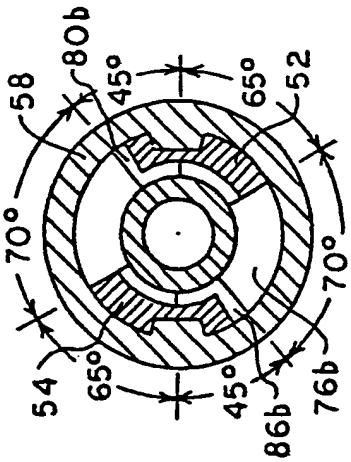

FIG. 26

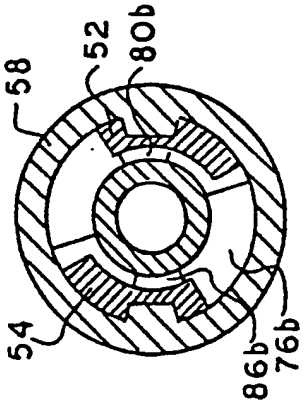

FIG. 25

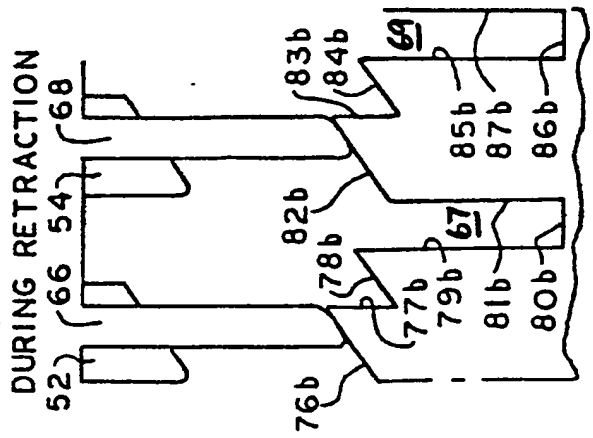

FIG. 24

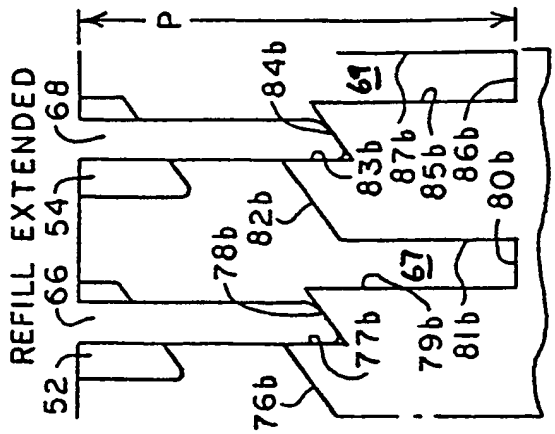

FIG. 23

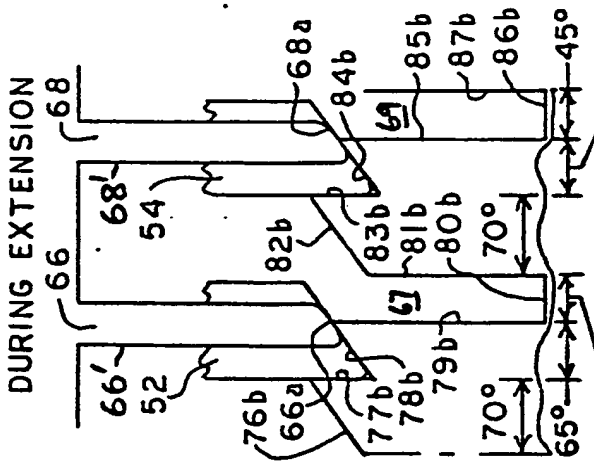

FIG. 22

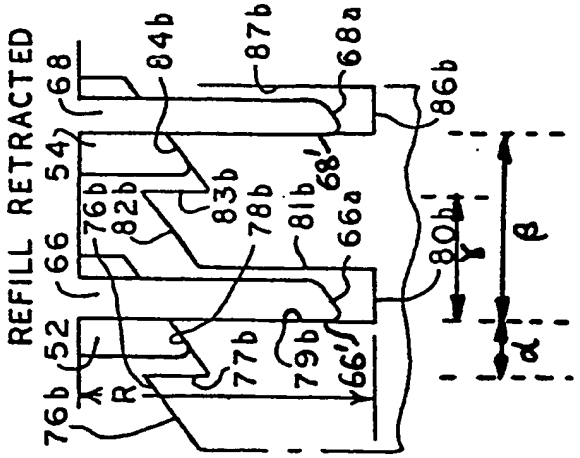

FIG. 21

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 87 30 5912

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-3 273 541 (THURMAN et al.) * Column 1, line 47 - column 5, line 75 *	1,8	B 43 K 24/08
A	FR-A-1 119 233 (THE PARKER PEN CO.) * Whole document, particularly figures 8-15,23-26 *	1,8	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 43 K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02-09-1987	VAN OORSCHOT J.W.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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